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A CIPHER-CODE FOR ASTRONOMICAL MESSAGES.*

BY EDWARD S. HOLDEN.

PRINCIPLES OF THE CIPHER-CODE.

Table I consists of 510 cipher-words of three letters each; as *Hil*=100. When a word of three letters occurs in a message, it signifies a *local date;* as *Hil*=100th day of the year=April 10 (in common years, April 9 in leap-years). The words of Table I are usually employed as prefixes to one of the five-letter affixes of Table II; as *Hilofant*=10072, making a *number*-word. In certain (specified) cases these numbers signify degrees and minutes of *arc*; as *Hiladize*=100° 05′ (the prefix always gives the degrees; the affix, the minutes). In certain other (specified) cases, the number-words are used to denote an accurate date (always in Greenwich days and hundredths of a day); as *Rokalone*=286^{d}.15=October 13^{d} 3^{h} 36^{m} G. M. T. (in any common year). See Tables III and V.

All number-words have eight letters. The use of Table III is obvious. Table IV contains in the second column certain arbitrary cipher-words (each one of six letters and of two syllables); and, in the third column, certain phrases or sentences, each corresponding to a single cipher-word. The third column of Table IV is essentially a copy of Part II of the "Science-Observer Code." The whole table contains more phrases than I should myself select, were the work to be done *ab initio*. Table V will be found convenient.

Any expert in cipher-codes will remark various precautions against mistakes of eye and ear which have been adopted in what follows. They have been suggested by experience in the use of the "Science-Observer Code" for transmitting astronomical telegrams, and of other codes for other uses.

I have to thank my colleagues at Mount Hamilton for valued advice and assistance in preparing these tables.

The great merit of the "Science-Observer Code" is in its system of

*See *Publications* A. S. P., Vol. VIII, page 64.

control-words, or checks. The present code contains the same checks, and has the additional advantages (among others):

First, that all the words of the telegram contain either three, six, or eight letters (except in the case of proper names), and thus that the cipher-words are short, and of uniform lengths.

Second, that all local dates (month and day only) are expressed by words of three letters.

Third, that all arbitrary cipher-phrases are denoted by words of six letters.

Fourth, that all accurate dates (G. M. T.), and all numbers, are expressed by cipher-words of eight letters.

The system of cipher adopted enables one to replace the first 203 (quarto) pages of the "Science-Observer Code" by our Tables I, II, III, which are printed on three (octavo) pages, thus saving much needless turning of leaves. The rest of the present code is simply an adaptation of the "Science-Observer Code." Members of the Astronomical Society of the Pacific, and others, may find the present code convenient for communications between themselves, and with the LICK Observatory.

GENERAL RULES FOR ASTRONOMICAL TELEGRAMS.

Dates.— When the date is given to the nearest day only, *by a three-letter word from Table I*, the date is always the *local* date of the observer (not of the person who sends the telegram). This avoids ambiguities. When the date is given to the decimal of a day, *by a compound-word from Tables I and II*, it is always expressed in Greenwich mean days and decimals. All days begin at noon.

Right Ascensions, differences in R. A., motions in R. A., are always expressed in *time*, (thus avoiding one of the chief annoyances in the use of the "Science-Observer Code." See its page 10, word 5, for example).

Declinations from $+90°$ to $-90°$ are always expressed as *North-polar-distances.*

Positions are understood to be referred to the apparent equinox of the date (except when otherwise especially noted in the precepts).

N. B.— Always send the full complement of words, filling (otherwise) blank spaces by the words *Baf* (Table I), *nicht* (Table II), or *voidness*, *zerotion*, etc.

The code is particularly useful in sending certain standard forms of telegrams (explained in what immediately follows), though it can be employed for any astronomical news. It will give little trouble to English-speaking folk; and can be used by Europeans. Finally, it is to be recollected that no cipher-telegram is suitable to replace a letter, or to convey very complex messages; and, therefore, the telegrams must be made short and correct, and information that can wait (as accurate ephemerides, etc.) transmitted by letter.

It may prevent mistakes to write five figures to correspond to every number-word; as, 00172 for 172, 01724 for 1724, 135° 05′ for 135° 5′, etc.

SEVENTEEN-WORD DISPATCH.

GIVING ELEMENTS AND EPHEMERIS. (See Table IV, No. 51051).

Word No. 1 = Time of perihelion passage = T.

Word No. 2 = Distance of perihelion from node = $\omega = \pi - \Omega$.

Word No. 3 = longitude of node = Ω.

Word No. 4 = inclination (which may range from 0° to 180°) = i.

N. B.—The elements 2, 3, 4 are referred to the mean equinox of the beginning of the year.

Word No. 5 = perihelion distance = q (not log q).

Word No. 6 = control-word = ¼ the sum of the five number-words 1, 2, 3, 4, 5.

Word No. 7 = first date of the ephemeris (*Greenwich date*), and the *light* for that date.

Word No. 8 = First R. A.
Word No. 9 = First N. P. D.
Word No. 10 = Second R. A.
Word No. 11 = Second N. P. D.
Word No. 12 = Third R. A.
Word No. 13 = Third N. P. D.
Word No. 14 = Fourth R. A.
Word No. 15 = Fourth N. P. D.

Four-day intervals are to be understood in the ephemeris. Positions refer to Greenwich mean midnight.

Word No. 16 = last date of ephemeris and *light* for that date.

Word No. 17 = *local mean* dates of the observations on which the elements depend. (See Table IV, No. 51122).

Detail of Seventeen-Word Dispatch.

Word No. 1.—The time of perihelion passage is given by an eight-letter number-word (made up of a prefix from Table I and of an affix from Table II). This gives the day of the year and the hundredths of a day. Thus T = Nov. $7^d.91$ G. M. T. = $311^d.91$ is expressed by *Sinugale* (see Tables I and III).

Word No. 2.—Distance of perihelion from node, = $\omega = \pi - \Omega$. This is expressed by an eight-letter number-word in degrees and minutes. Table I gives the degrees, Table II the minutes. Thus, $\omega = 99° 34'$ is expressed by *Hikelope*.

Word No. 3.—Longitude of node, in arc, as for word No. 2. Thus, $\Omega = 300° 50'$ is *Safilade*.

Word No. 4.—Inclination = i, in arc, as above. Thus, $i = 7° 22'$ is *Bazaside*.

Word No. 5.— Perihelion distance = q. This element is to be expressed in units of the *fourth* decimal place. Thus, $q = 1.1049$ is *Horijest*.

Word No. 6.—This word is inserted to enable the receiver of the message to be certain that the foregoing elements have been correctly received (and translated). Errors in transmission can sometimes be corrected by its aid. It is determined by adding all the numbers corresponding to words 1, 2, 3, 4, 5, and by dividing their sum by 4.

N. B.—In making this addition, be careful to express such angles as 135° 5′ in the form 135.05, etc.

Example: T = 311 91.
ω = 99 34.
Ω = 300 50.
i = 7 22.
q = 110 49.

Sum = 829 46.

¼ sum = 207 36, and the control-word is *Lunendow.*

Word No. 7.—The first date for the ephemeris, and the light for that date. This will be expressed by a number-word of eight letters, as *Pinative* = 25124. The affix (24) gives *the Greenwich day* corresponding to the first date of the ephemeris. The month itself must be inferred from the date of the telegram. If this is dated May 20, the first date of the ephemeris is May 24. The *light* of the comet at discovery is always assumed to be 1.0. The *prefix* of word No. 7 gives the *light* on the first date of the ephemeris, expressed in units and *tenths* (not hundredths). Thus, B = 25.1.

N. B.—If the date of discovery is not known, the light of the comet at the first date of the ephemeris is to be assumed to be 1.0, and in this case (and in one other case *only*) the prefix to Word No. 7 will be *Bil.* The other (very improbable) case is when the comet does not change its brilliancy between discovery and the first date of the ephemeris.

Word No. 8.—First R. A. of ephemeris. This will be expressed by a single number-word of eight letters; as *Moyirize* = 23162, which is to be read as $23^h\ 16^m.2$; *i. e.*, the three figures on the right *always* express minutes and tenths of minutes of *time*, and the remaining figures, hours of R. A. ($0^h\ 7^m.0$ should be written 00070 = *Bafocean;* $11^h\ 0^m.0$ should be written 11000 = *Hornicht*).

$0^m.1$ is the most convenient unit for R. A. positions in an ephemeris sent *by telegraph.* The object will always fall in the field of the eye-piece employed for comets. It is entirely unnecessary to give the R. A. to 1′ of arc.

Word No. 9.—First N. P. D. This will be given by a number-word of eight letters, which corresponds to degrees and minutes of arc. Thus, δ = 46° 56′, or N. P. D. = 43° 04′ = *Ditadieu.* (δ = —47° 51′ = N. P. D. 137° 51′ = *Jolilant*).

Word No. 10.—Second R. A.
Word No. 11.—Second N. P. D.
Word No. 12.—Third R. A.
Word No. 13.—Third N. P. D.
Word No. 14.—Fourth R. A.
Word No. 15.—Fourth N. P. D.

} Each will be expressed by a number-word of eight letters, precisely as for words No. 8 and No. 9, corresponding to *four-day* intervals in the ephemeris.

Word No. 16.—Last date and *light* of the ephemeris. This, like Word No. 7, will be expressed by a number-word of eight letters; as *Sipadize* = 31205. The day of the month is 05, and must correspond (see Word No. 7) to June 5, since the last date of the ephemeris is twelve days later than the first (May 24), which constitutes a rough control. B = 31.2.

Word No. 17.—Local mean date of first observation (*prefix*), and interval in days between the first and second observations (first figure of *affix*), and between the second and third observations (second figure of *affix*). The cipher-word will be a number-word of eight letters; as *Juneting* = 14741. The first observation was on May 27 (147^d), if the year was not a leap-year; the second observation was four days later (May 31); the third observation was one day later (June 1).

N. B.—Should any *interval* be *greater than nine days*, write the word *nicht* as the affix. Thus, *Junnicht* = 14700 indicates that the first observation upon which the orbit is based was made on May 27 (147^d), and that at least one of the intervals between the first and second, and second and third observation, is greater than nine days—and thus, that the ephemeris is likely to be accurate. See Table IV, No. 51122.

Example: Elements and ephemeris of Comet *Pechule*, 1880, (from "Science-Observer Code," page 8). N. B.—1880 is a leap-year.

		ELEMENTS. I.	II.
1.	T=Nov. 9.62 G. M. T.	= 314 62 = *Sod-irize*,	(Manceps).
2.	$\omega = 13° 21$	013 21 = *Bit-aship*,	(Aguijoso).
3.	$\Omega = 249° 39'$	249 39 = *Pik-eroon*,	(Hellhag).
4.	$i = 60° 41'$	060 41 = *Faf-eting*,	(Bifidate).
5.	$q = 0.6775$	067 75 = *Faz-ogive*,	(Bostezante).
		Sum, 705 38	
6.		¼ sum, 176 34 = *Kul-elope*,	(Efforts).
		EPHEMERIS.	
7.	Jan. 7 = 7; Brightness = 1.0,	01007 = *Bil-aflow*,	(Breastwork).
8.	R. A. $20^h\ 32^m.4$	20324 = *Lud-ative*,	(Macropod).
9.	N. P. D. 67° 10′	06710 = *Faz-aglow*,	(Bordadora).
10.	R. A. $20^h\ 49^m.9$	20499 = *Luf-useep*,	(Malhetada).
11.	N. P. D. 65° 29′	06529 = *Far-egate*,	(Bochista).
12.	R. A. $21^h\ 6^m.9$	21069 = *Maf-oblat*,	(Manifatura).
13.	N. P. D. 63° 56′	06356 = *Fan-inary*,	(Blanquero).
14.	R. A. $21^h\ 23^m.4$	21234 = *Mal-elope*,	(Marooned).
15.	N. P. D. 62° 32′	06232 = *Fal-ejekt*,	(Bisneto).
16.	Jan. 19 = 19; Brightness = 0.66,	00719 = *Baz-arose*,	(Enviscar).
17.	First observation, Dec. 18 = 353^d Second observation, Dec. 22 = 4^d later Third observation, Dec. 30 = 8^d later	35348 = *Tud-ifold.*	(Nagueres).

Column I gives the required message expressed by the present code. It is pure jargon, arranged on a systematic plan. The telegrapher and the receiver (over a telephone-wire especially) must pay attention throughout, and every word *must* contain eight letters, neither more nor less. Column II gives the same message expressed in the "Science-Observer Code." I submit that its jargon has all the disadvantages of Column I, and that it has others peculiar to its own fundamental system. The message as in Column I can be written with one opening of the book, and in a very much shorter time than that in Column II. In

practice, the form on the left of the page is first prepared; next, the prefixes are entered from Table I, and, lastly, the affixes from Table II.

SIX-WORD POSITION-MESSAGE.

All such messages, and only such, begin with the name of a month.

Following is a scheme of a six-word position-message, which is well adapted to send either an accurate or an approximate position.

Word No. 1.—Month of the date of the observation (in English; as *January*).

Word No. 2.—A number-word of eight letters, giving the Greenwich day and thousandths of a day. Thus, *Sik-orous* = 30989 = $30^d.989$ G. M. T. (day begins at noon).

Word No. 3.—A number-word of eight letters, which gives the hours, minutes, and the tens of seconds of time of the position in R. A. Thus, *Mitodate* = 22371 = $22^h\ 37^m\ 1\_^s$.

Word No. 4.—A number-word of eight letters, which gives the N. P. D. to the next less 1′; as *Kinarine* = 161° 20′.

Word No. 5.—A number-word of eight letters, which gives—*first*, the fourth decimal of the day (date); *second*, the units and the tenths of seconds of time (R. A.); *third*, the seconds of arc (N. P. D.). Thus, *Rif-eroon* = 27839, meaning $0^d.0002$ (to be added to the data of Word No. 2, making the date $30^d.9892$), and $7^s.8$ in R. A. (to be added to the data of Word No. 3, making the R. A. $22^h\ 37^m\ 17^s.8$), and 39″ in N. P. D. (to be added to the data of Word No. 4, making the N. P. D. 161° 20′ 39″).

Word No. 6.—A number-word of eight letters, used as a control, and representing one-fourth of the sum of words 2, 3, 4, and 5.

N. B.—To send an *approximate* position, proceed precisely as above, *except* that Word No. 5 must be replaced by the arbitrary cipher-word, *Nearness*, which shows the receiver that an approximate place is intended.

N. B.—See Table IV, No. 51121.

THIRTEEN-WORD MESSAGE.

ANNOUNCEMENT OF A DISCOVERY.

N. B.—Always fill up the full complement of words. The six-word message will find its application here.

Word No. 1.—Phrase-word (Table IV) of six letters and two syllables, naming the object discovered; as *bushel* = A comet was discovered by———at———on———.

Word No. 2.—Discoverer's name; if unknown, put *question*.

Word No. 3.—Discoverer's station; if unknown, put *unknown*.

Word No. 4.—Date of discovery; if unknown, put *nix*.

If the *day* of discovery (only) is known, Word No. 4 will be of three letters; as November 20, *local date* (common year) = 324^d = *Suf*; otherwise, of eight letters, giving the Greenwich day and hundredths of a day; as *Suf-egate* = $324^d.29$ G. M. T.

Words Nos. 5, 6, 7, 8, 9, 10.—Six-word position-message, exactly as above (words of eight letters from Tables I and II).

Word No. 11.—Daily motion in R. A. in seconds of time, which will always be given by a number-word of eight letters; as *Dilatrip*=4025^s.

N. B.—If unknown, write *voidness*.

Word No. 12.—Daily motion in N. P. D. in *minutes* and tenths of minutes* (not degrees and minutes) of arc, which will always be given by a number-word of eight letters, as *Bak-imony*=15.5′.

N. B.—If unknown, write *zerotion*.

Word No. 13.—Direction of motion in R. A. and N. P. D. Send one of the five words (from Table IV) following:

beetle=the daily motions are north and west.

beggar=the daily motions are north and east.

behave=the daily motions are south and west.

behest=the daily motions are south and east.

become=the daily motions are unknown both in amount and direction.

N. B.—Always fill up the full complement of thirteen words. They are sometimes unnecessary, it is true; they always cost slightly more than eight or ten; but if all the information can be sent it is important; and if any item of it is unknown that fact should be explicitly stated.

Example of Announcement of Discovery Message.

The message to be sent is: "A faint comet was discovered by Barnard at Nashville on October 14. Its position October 15 at 9^h 30^m 15^s is R. A. 2^h 27^m 13^s.5, N. P. D. 27° 13′ 23″. Its daily motion in R. A. is (—72^s), and in N. P. D. (—8′).

Word 1=Phrase-word, Table IV=*Butter* (No. 51082).

Word 2=Discoverer's name=*Barnard*.

Word 3=Discoverer's station=*Nashville*.

Word 4=Date October 14=287^d (not leap year)=*Rol*.

Word 5=October=*October*.

Word 6=15^d 9^h 30^m 15^s=15.396 (o)=*Kan-upate*.

Word 7=R. A. 2^h 27^m 1—^{s}=02271=*Boz-odate*.

Word 8=N. P. D. 27° 13′ (23″)=02713=*Bun-alist*.

Word 9 { =Fourth decimal of the day=0; =Seconds of R. A. 3^s.5 =035; =Seconds of N. P. D. 23″ =00023; Aggregate=03523 } =*Dar-ation*.

Word 10.—Control-word=*Duz-ogoon*.

Formed thus:

15396
02271
02713
03523

Sum, 23903; ¼ sum=05976.

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*The tenths, not necessary here, are used so as to be consistent with Table IV, No. 51029, where they are necessary.

Word 11.—Daily motion in R. A. = —72ˢ = *Baf-ofant.*
Word 12.—Daily motion in N. P. D. = —08′.0 = *Baf-olute.*
Word 13.—The motion is north and west = *beetle.*

REMARK.

The control-words in the various messages can be employed to correct errors of transmission as well as to detect their existence.

SHORT INDEX TO TABLE IV.

Phrases, TABLE IV. Arbitrary Cipher-Code.

It is sometimes convenient, and it always saves expense, to have a phrase-code in which arbitrary words in the telegram stand for whole sentences in the translation.

In my opinion, such tables are generally too long.

The following table is essentially a copy of the "Science-Observer Code" sentences (and precepts), with different cipher-words, however. Every cipher-word belonging in this table has two syllables and six letters; no more, no less. I have added a few needed phrases.

Each word in Table IV is numbered, as *babble*=51000. By previous agreement between two correspondents the cipher-words (second column), may be used to transmit the numbers in the first column. The blank spaces in the third column can be filled in, by agreement, as new wants arise.

No.	Cipher-Word.	Corresponding Phrase.
51000	babble=	*The exact Greenwich mean time* (day begins at noon) *is* or *was*——— N. B.—The time is to be expressed in days and decimals of a day. *Example:* Babble Roneglet=the G. M. T. is $288^d.30$= Oct. $15^d\ 7^h\ 12^m$. Babble Roneglet Bodakute=Oct. $15^d\ 7^h\ 12^m\ 12^s.2$ ($+0^d.0001412$).
51001	baboon=	*The object is in the Bonn DM.* (between $+90°$ and $+0°$ Decl.).
51002	badger=	*The object is in the Bonn DM.* (between $0°$ and $-23°$ Decl.).
51003	ballad=	
51004	ballot=	*The object is in the C. G. H. (photographic) DM.*
51005	bandit=	*The object is in the Cordoba (visual) DM.*
51006	banyan=	N. B.—The Cipher-words for DM. stars will be followed by two number-words. *First.*—The *prefix* to the first word gives the Decl. of the zone. (See the top of the page in the DM.). *Second.*—The *affix* to the first word gives the magnitude of the star, in tenths of a magnitude, where 9.9 is assumed to be the magnitude of every star fainter than 9.8. *Third.*—The second word gives the star's number in its zone. Thus, if there were a Bonn DM. star of 9.6 mag. $-13°$ Decl., No. 4417 in that zone, we could denote it by *badger, bitupate* 13, 96 *dodamope.* 4417
51007	banker=	*The object is on the photographic plates taken at the Observatory of*——— N. B.—The cipher-word is followed by the name of the observatory; as Harvard, Paris, Naples.

No.	Cipher-Word.	Corresponding Phrase.
51008	barber=	*The object is not on the negatives taken at*———
51009	barley=	*The object is in Dreyer's New General Catalogue of Nebulæ*, No.——(if followed by a number-word).
51010	barrel=	*The object is in Dreyer's Index-Catalogue of Nebulæ*, 1888–94, No.——(if followed by a number-word). N. B —The cipher-word may be followed by a number-word of eight letters, which gives the number of the object in the catalogue referred to.
51011	barrow=	
51012	barter=	The object follows the (star) next named by——— seconds of time (prefix).
51013	basely=	The object precedes the (star) next named by——— seconds of time (prefix).
51014	bashaw=	The object is north of the (star) next named by——— minutes of arc (affix).
51015	basket=	The object is south of the (star) next named by——— minutes of arc (affix). N. B —Two of the cipher-words will be followed by a number-word whose *prefix* gives Δ R. A., and whose *affix* gives Δ δ. N. B.—Name the comparison star afterwards. For exact positions, see page 114.
51016	bathos=	*and is north-preceding (the object next named in the message).*
51017	battle=	*and is north-following (the object next named in the message).*
51018	bawble=	*and is south-following (the object next named in the message).*
51019	beacon=	*and is south-preceding (the object next named in the message).*
51020	beater=	*the position with reference to*———
51021	beauty=	*the position angle is*——(number-word; *deg. and min.*).
51022	beaver=	*the distance is*——(number-word; *seconds of arc*).
51023	become=	The daily motions are unknown both in amount and direction.
51024	beetle=	*The daily motion of the comet (or object) is towards north and west.*
51025	beggar=	*The daily motion of the comet (or object) is towards north and east.*
51026	behave=	*The daily motion of the comet (or object) is towards south and west.*
51027	behest=	*The daily motion of the comet (or object) is towards south and east.*
51028	behold=	*The amount of the daily motion in R. A. is (in seconds of time).* N. B.—The cipher-word is to be followed by a number-word, always of eight letters, which expresses the daily motion in seconds of time. This will always be less than 50999^s.
51029	behoof=	*The amount of the daily motion in N. P. D. is (in minutes and tenths of minutes of arc).* N. B.—The cipher-word is to be followed by a number-word, always of eight letters, which expresses the daily motion in N. P. D in minutes and tenths of minutes of arc. This will be less than $5099'.9$.

No.	Cipher-Word.	(See 51071). Corresponding Phrase. (See 51122).
51030	beldam=	
51031	belfry=	
51032	bellow=	
51033	belong=	*The* elements *of Comet a are* (See 51068).
51034	bemoan=	*The elements of Comet b are*
51035	benign=	*The elements of Comet c are*
51036	bestir=	*The elements of Comet d are*
51037	betake=	*The elements of Comet e are*
51038	betray=	*The elements of Comet f are*
51039	better=	*The elements of Comet g are*
51040	bewail=	
51041	beware=	
51042	beyond=	*The* ephemeris *of Comet a follows.*
51043	bicker=	*The ephemeris of Comet b follows.*
51044	biffin=	*The ephemeris of Comet c follows.*
51045	billet=	*The ephemeris of Comet d follows.*
51046	billow=	*The ephemeris of Comet e follows.*
51047	binder=	*The ephemeris of Comet f follows.*
51048	bisect=	*The ephemeris of Comet g follows.*
51049	bitter=	
51050	blazon=	
51051	bobbin=	*The* elements and ephemeris *of Comet a follow.*
51052	bodice=	*The elements and ephemeris of Comet b follow.*
51053	bodkin=	*The elements and ephemeris of Comet c follow.*
51054	bolter=	*The elements and ephemeris of Comet d follow.*
51055	bonnet=	*The elements and ephemeris of Comet e follow.*
51056	border=	*The elements and ephemeris of Comet f follow.*
51057	borrow=	*The elements and ephemeris of Comet g follow.*
51058	bother=	
51059	bottle=	
51060	bounty=	*An* ephemeris *of three positions at four-day intervals.*
51061	boxing=	*An ephemeris of four positions at four-day intervals.*
51062	boyish=	*An ephemeris of six positions at four-day intervals.*

No.	Cipher-Word.	Corresponding Phrase.
51063	brandy=	*An* ephemeris *of eight positions at four-day intervals.*
51064	brassy=	*An ephemeris of three positions at eight-day intervals.*
51065	brawny=	*An ephemeris of four positions at eight-day intervals.*
51066	breezy=	*An ephemeris of six positions at eight-day intervals.*
51067	brewer=	*An ephemeris of eight positions at eight-day intervals.*
51068	briber=	*Compare the elements sent you with those of the——— Comet of———.* (See Publ. A. S. P., No. 50). N. B.—The cipher-word is followed by a number-word of eight letters. *First.*—Write out the number corresponding. *Second.*—Cut off the last figure, which gives the number of the comet in the year. *Third.*—The first four figures give the year A. D.
51069	bridal=	
51070	broken=	*The* auxiliary constants *for the equator to be used in computing an ephemeris are as follows:* N. B.—The cipher-word will always be followed by seven number-words of eight letters, the first six representing $a\ b\ c$, A, B, C, in the equations. $x = r \sin a \sin (A+v)$ $y = r \sin b \sin (B+v)$ $z = r \sin c \sin (C+v)$ The angles are expressed in degrees (corresponding to the prefix) and minutes (the figures of the affix always represent the minutes). The seventh number-word is a control-word, and represents one-fourth of the sum of the preceding six words. *Example:* $a=81^\circ\ 21'$, $b=76^\circ\ 23'$, $c=16^\circ\ 20'$, $A=170^\circ\ 41'$, $B=262^\circ\ 17'$, $C=49^\circ\ 11'$ would be represented by *broken* 1. *Foyaship* =081 21 2. *Fokation* =076 23 3. *Bokarine* =016 20 4. *Koreting* =170 41 5. *Pozamope* =262 17 6. *Dopahold* =049 11 One-quarter of $\overline{(655\ 33)}$ = 163 83 = *Kitomous*, which is the control-word.
51071	brutal=	*These are* elliptic elements *which follow:* N. B.—The cipher-word will be followed by two number-words of eight letters. The first gives the eccentricity (e) to the nearest fourth decimal place; the second gives the periodic time expressed in years and hundredths of a year.
51072	bubble=	*The deviation* $(C-O)$ *of the middle place when* $+$ *in* λ *and* $+$ *in* β *is*
51073	bucket=	*The deviation* $(C-O)$ *of the middle place when* $+$ *in* λ *and* $-$ *in* β *is*
51074	budget=	*The deviation* $(C-O)$ *of the middle place when* $-$ *in* λ *and* $+$ *in* β *is*
51075	buffer=	*The deviation* $(C-O)$ *of the middle place when* $-$ *in* λ *and* $-$ *in* β *is* N. B.—The cipher-words will be followed by a number-word of eight letters, the first three figures of which give $\Delta\lambda \cos\beta$, and the last two figures of which give $\Delta\beta$, both expressed in minutes and tenths of arc. *Example:* $(C-O) = -18'.8$ ($\Delta\lambda \cos\beta$ = *buffer*); $-0'.6$ ($\Delta\beta$ = *Lifadore*) is expressed by 188 06

No.	Cipher-Word.	Corresponding Phrase.
51076	bullet=	*The position of the observed place with reference to the predicted place (C—O) is, approximately,*
	1. Add to *bullet* the word *bubble* for ΔR.A.+, ΔN.P.D.+; (C—O). 2. *bucket* for ΔR.A.+, ΔN.P.D — 3. *budget* for ΔR.A.—, ΔN.P.D.+ 4. *buffer* for ΔR.A.—, ΔN.P.D.—	N. B.—The cipher-word will be followed by a cipher-word (see adjacent column) and by one number-word of eight letters. The affix gives (C—O) in R. A. expressed in seconds of time. The prefix gives (C—O) in *north polar distance* expressed in minutes and tenths of minutes of arc.
51077	bunker=	*The (C—O) is not known.*
51078	burden=	*The* physical appearance *of the object is as follows:* N. B.—The cipher-word will be followed by English words describing the appearance as "bright," 'circular," "large," etc., as desirable.
51079	bushel=	*A* comet *was discovered by*———, *at*———, *on*———.
51080	buskin=	A *bright comet was discovered by* ———, *at*———, *on*———.
51081	bustle=	*A very bright comet was discovered by*———, *at*———, *on*———.
51082	butter=	*A faint comet was discovered by* ———, *at*———, *on*———.
51083	byword=	*A very faint comet was discovered by*———, *at*———, *on*———.
51084	dagger=	*A* planet *was discovered by*———, *at*———, *on*———.
51085	damage=	*A planet fainter than 13 mag. was discovered by*———, *at*———, *on* ———. N. B.—The cipher-word will be followed by three words giving 1°) name of discoverer 2°) his station 3°) a date-word of three letters from Table I (the day is expressed in local mean time (day begins at noon).
51086	damask=	*A comet was found on the negatives of*———.
51087	damsel=	*A planet was found on the negatives of*———.
51088	danger=	
51089	dapple=	*The periodic comet of*———*has been observed by*———, *at*———, *on* ———. N. B.—The cipher-word is followed by four words giving 1°) name of comet 2°) observer 3°) his station 4°) date-word of three letters (the day is expressed in the local mean time of the observer).
51090	dawdle=	*Possibly a comet.*
51091	dazzle=	*Probably a comet.*

No.	Cipher-Word.	(See pp. 128–9). Corresponding Phrase.
51092	deacon =	*Not a comet.*
51093	dealer =	*Possibly a planet.*
51094	debase =	*Probably a planet.*
51095	debate =	*Possibly a nebula.*
51096	decree =	*Probably a nebula.*
51097	deface =	*The comet was looked for, but not found.* (See 51223).
51098	defect =	*The planet was looked for, but not found.* (See 51223).
51099	defend =	*Please observe* markings *on*———(Mercury, Venus, etc.)———.
51100	defile =	*A marking on the planet*———*is central at*——— (*Greenwich date*).
51101	deject =	*Please observe* (photograph) changes in the tail of Comet———.
51102	deluge =	*Please observe changes in the head of Comet*——— (*now in progress*).
51103	dental =	*Bright projection on* Mars' *terminator at* (*Greenwich date*).
51104	depend =	
51105	depict =	*Please send* by mail *an observation of as early a date in the year as you can.*
51106	deploy =	*Please send by mail an observation of as late a date in the year as you can.*
51107	depose =	*Please send by mail any observation.*
51108	depute =	*Please send by mail two observations.*
51109	deride =	*Please send by mail three observations.*
51110	desert =	*Please send by mail elements and ephemeris.*
51111	design =	*Please* telegraph *an observation of as early a date in the year as you can.*
51112	desist =	*Please telegraph an observation of as late a date in the year as you can.*
51113	despot =	*Please telegraph any observation.*
51114	detail =	*Please telegraph two observations.*
51115	detect =	*Please telegraph three observations.*
51116	detest =	*Please telegraph any data you can.*
51117	device =	*Please telegraph elements.*
51118	devoid =	*Please telegraph ephemeris.*
51119	devour =	*Please telegraph elements and ephemeris.*
51120	differ =	*Was discovered by*——— (*at*———, *on*———).
51121	digest =	*Was observed by*——— (*at*———, *on*———).
51122	dilate =	*Was computed by*——— (*at*———, *on*———).

No.	Cipher-Word.	Corresponding Phrase.
51123	dimple =	*A* variable *star was found on the negatives of*———.
51124	dipper =	*A* new *star was found on the negatives of*———.
51125	direct =	*The variability of the star (object) was discovered by* ——— (*at*———, *on*———).
51126	disarm =	*A new star was discovered by*——— (*at*———, *on* ———). See No. 51144. See Nos. 51147-8. N. B.—The two cipher-words just preceding will be followed by three words 1°) the discoverer's name 2°) his station 3°) a date-word of three letters from Table I (the day should be expressed in local mean time of observer).
51127	dismal =	*Possibly this object is variable.*
51128	distil =	*Probably this object is variable.*
51129	divert =	*The epoch of maximum and period are*———
51130	divine =	*The epoch of minimum and period are*——— N. B.—The two foregoing cipher-words will be followed 1°) by a number-word, which will give the epoch in Greenwich days and hundredths of a day, and 2°) by a number-word, which will give the period in days and hundredths of a day.
51131	docile =	*A minimum occurred on*———
51132	doctor =	*A minimum will occur on*———
51133	dollar =	*A maximum occurred on*———
51134	domain =	*A maximum will occur on*——— N. B.—These cipher-words will be followed by 1°) a date-word of three letters giving the local mean day, or 2°) by a number-word of eight letters giving the day and hundredth of a day (G. M. T.).
51135	dotage =	*The epoch and period are not known.*
51136	dragon =	*The period is short.*
51137	dreamy =	*The period is long.*
51138	dressy =	*The variable is of the Algol type.*
51139	drivel =	*The variable is of the Eta Aquilæ type.*
51140	drover =	*A shower of* meteors *is now in progress.*
51141	duster =	*A shower of meteors will probably occur* (Greenwich date).
51142	fabric =	*The radiant is* or *was*———. N. B.—The cipher-word will be followed by two number-words, giving 1°) R. A. in hours, minutes, and tenths of minutes; 2°) N. P. D. in degrees and minutes.

No.	Cipher-Word.	Corresponding Phrase.
51143	facile=	*The* variation *in magnitude is*———.

N. B.—The cipher-word will be followed by a number-word of eight letters 1°) the first three places give the max. brightness in mags. and tenths 2°) the last two places (mags. and tenths) added to the max. brightness give the minimum brightness in mags. and tenths).

Example: The variability of BD+1°, 3408 was discovered by SAWYER, at Cambridge, February 17 (local date). The epoch of minimum is July 17, $15^h\ 45^m$ G. M. T., and the period is $0^d\ 20^h$. The variation of mag. is from 6.0 to 6.8. The variable is of the *Algol* type. These facts are expressed as follows:

Direct	The variability of the star was disc. by——.
Sawyer	
[at] (*Cambridge*)	
[on] *Don*	[The date of discovery is Feb. $17=48^d$.]
baboon	[The star is in the B. D., north of 0°.]
Bakiptik	[Decl. + 1°, mag. 6.0.]
Dapafras	[The number in the zone 3408.]
Divine	[The epoch of minimum is——.]
Lonitous	[July 17, $15^h\ 45^m=198^d.65$.]
Bafomous	[The period is $0^d.83$]
Facile	[The variation in brightness is——.]
Fafafras	[The max. brightness is 6.0, the min. 6.8.]
Dressy	[The variable is of the *Algol type*.]

N. B.—Be careful to give similar messages in this precise order.

51144	factor=	*Has suddenly appeared.*
51145	falcon=	*Will appear in the Northern Hemisphere.*
51146	fallow=	*Will appear in the Southern Hemisphere.*
51147	famish=	*The* magnitude *is as follows* (*when brighter than 10.0 mag.*).
51148	father=	*The magnitude is as follows* (*when fainter than 10.0 mag.*).

N. B.—The cipher-words will be followed by a number-word, or by several number-words each of eight letters. Each number-word is to be written out in figures. The first three figures represent the day of the year (G. M. T.). The last two figures give the mag. directly (when the star is brighter than 10), or they give the (mag.—10.0) in case the cipher-word is "father."

51149	fathom=	*There is a large, or remarkable, spot on the sun.*
51150	fatten=	*There is a remarkable protuberance on the sun.* (See No. 51021).
51151	faulty=	*There seems to be an inter-mercurial planet on the sun.*
51152	feeble=	*There seems to be a comet on the sun.*
51153	feline=	*A bright comet is near the sun.* (See 51012, etc.).
51154	fencer=	*Please observe a probable* occultation *by Comet*——— (G. M. T.).
51155	fender=	*The planet next named will occult a star on* (Greenwich date).
51156	ferret=	*Please observe an occultation on*——— (Greenwich date).
51157	fetter=	*Changes in the Moon's surface are reported by*———. (See 51158–61).

No.	Cipher-Word.	Corresponding Phrase.
51158	fickle=	*The object is on Schmidt's lunar map in* $+\lambda$ *and* $+\beta$,
51159	fidget=	*The object is on Schmidt's lunar map in* $+\lambda$ *and* $-\beta$,
51160	fillet=	*The object is on Schmidt's lunar map in* $-\lambda$ *and* $+\beta$,
51161	finder=	*The object is on Schmidt's lunar map in* $-\lambda$ *and* $-\beta$. N. B.—If cipher-words 51158-51161 are followed by a number-word, the *prefix* gives λ, the *affix* β, expressed in degrees.
51162	finger=	*The* spectrum *is continuous.*
51163	finite=	*The spectrum is normal.*
51164	fisher=	*The spectrum is monochromatic.*
51165	flagon=	*The spectrum is peculiar.*
51166	flashy=	*The spectrum is like that of a comet.*
51167	flaxen=	*The spectrum is like that of a nebula.*
51168	flinty=	*The stellar spectrum is type* I (Secchi),
51169	floral=	*The stellar spectrum is type* II (Secchi),
51170	flower=	*The stellar spectrum is type* III (Secchi),
51171	fluent=	*The stellar spectrum is type* IV (Secchi).
51172	flurry=	*The stellar spectrum is type* (Wolf-Rayet).
51173	foment=	*The hydrogen lines are bright.*
51174	forage=	*The hydrogen lines and* D_3 *are bright.*
51175	forger=	*The spectrum contains bright lines or bands.*
51176	formal=	*The spectrum contains dark lines or bands.*
51177	fossil=	*Please observe the following line(s)*———. N. B.—Each number-word (of eight letters), following these cipher-words gives the wave length of a single line (or band), in millionths of a millimeter.
51178	freely=	*The spectrum has been* photographed *at*———.
51179	frenzy=	*The object has been photographed at*———.
51180	frigid=	*The region has been photographed at*———.
51181	frolic=	*The object has been photographed here.*
51182	frosty=	*The spectrum has been photographed here.*
51183	frugal=	*The region has been photographed here.*
51184	fuller=	*The* color *of the object is white.*
51185	funnel=	*The color of the object is very blue.*
51186	furrow=	*The color of the object is blue.*

No.	Cipher-Word.	Corresponding Phrase.
51187	fusion=	*The color of the object is yellow.*
51188	halter=	*The color of the object is red.*
51189	hammer=	*The color of the object is very red.*
		MISCELLANEOUS.
51190	harbor=	*The* magnitude *is not known.*
51191	harrow=	*The magnitude is brighter than*———
51192	hatred=	*The magnitude is fainter than*———
51193	hazard=	*The magnitude is equal to*———. (See 51147-8).
51194	heaven=	*The variation is large.*
51195	hector=	*The variation is small.*
51196	helmet=	*The* brightness *is increasing.*
51197	herald=	*The brightness is decreasing.*
51198	hermit=	*The brightness is increasing rapidly.*
51199	hollow=	*The brightness is decreasing rapidly.*
51200	homely=	*The brightness has increased rapidly.*
51201	honest=	*The brightness has decreased rapidly.*
51202	humane=	*It is* visible *to the naked eye.*
51203	hunger=	*It will become visible to the naked eye.*
51204	hussar=	*It will become very brilliant.*
51205	keeper=	*A suspicious object.*
51206	kennel=	*Greater than.*
51207	kidnap=	*Less than.*
51208	kingly=	*The earliest* observation *known is.*
51209	lackey=	*The latest observation known is.*
51210	lagoon=	*At several observatories.*
51211	lament=	*By several astronomers.*
51212	lancet=	*On several nights.*
51213	larder=	*The following observatories.*
51214	latent=	*The following observations.*
51215	lavish=	*Corrections for parallax and aberration have been applied.*
51216	leader=	*Corrections for parallax ana aberration have not been applied.*
51217	leaven=	*is a rough approximation.*

No.	Cipher-Word.	Corresponding Phrase.
51218	ledger=	*is still uncertain.*
51219	legate=	*is quite accurate.*
51220	lentil=	*The* position *is*———
51221	levant=	*The position used is*———
51222	levite=	*The position is not known.*
51223	lictor=	*The* object *was looked for, but not found.* (See 51097).
51224	limber=	*The object has been seen.*
51225	linden=	*The object has not been seen.*
51226	lining=	*The object has not been seen here since discovery.*
51227	linnet=	*The object has not been seen by any one else.*
51228	lizard=	*The object was not observed till*———
51229	loafer=	*The object has not been observed since*———
51230	locker=	*The object cannot be observed until*———
51231	locust=	*The object cannot be observed after*———
		Weather; Longitude Campaign.
51232	lodger=	*On account of moonlight, or twilight.*
51233	lordly=	*On account of clouds.*
51234	lubber=	*On account of moonlight, twilight or clouds.*
51235	lumber=	*It is cloudy here.*
51236	madman=	*It has been cloudy here.*
51237	magnet=	*It probably will be cloudy here.*
51238	magpie=	*Is it cloudy at your station?*
51239	maiden=	*Signals will be sent to-night at*———G. M. T.
51240	malice=	*Signals will be sent to-morrow at*———G. M. T.
51241	manful=	*Repeat exchange of signals to-night at*———G. M. T.
51242	mangle=	*No more signals to-night.*
51243	marble=	*Was exchange of signals satisfactory? Answer immediately.*
51244	marine=	*How many more nights' work needed at this station?*
51245	market=	*Your signals are not satisfactory.*
51246	marmot=	*My clock-correction is well determined.*
51247	marrow=	*My clock-correction is* not *well determined.*

No.	Cipher-Word	Corresponding Phrase.
		CORRESPONDENCE. (See page 122).
51248	martin=	*Our letter.*
51249	marvel=	*Our telegram.*
51250	master=	*Your letter.*
51251	matron=	*Your telegram.*
51252	meddle=	*Your letter has been received.*
51253	medium=	*Your telegram has been received.*
51254	menace=	*Answer by letter.*
51255	mental=	*Answer by telegraph.*
51256	method=	*We have written.*
51257	midway=	*We will write.*
51258	mildew=	*We have telegraphed.*
51259	miller=	*We will telegraph.*
51260	mingle=	*We are sure.*
51261	mirror=	*We are not sure.*
51262	mishap=	*Is right.*
51263	missal=	*Is not right.*
51264	mister=	*Was found to be.*
51265	modest=	*Is supposed to be.*
51266	morbid=	*Is not supposed to be.*
51267	mortal=	*Please repeat your last telegram.*
51268	mother=	*There was an* error *in my telegram.*
51269	motley=	*There was an error in my letter.*
51270	muddle=	*Instead of———, read———*
51271		N. B.—The cipher-word is to be followed by two words; the first gives the erroneous datum; the second the correct one.
51272	murder=	*Will be sent.*
51273	muslin=	*Cannot be sent.*
51274	mutton=	*Cannot be sent by telegraph* (see my letter).
51275	mystic=	*Do you want positions?*
51276	[nix]=	We do not know the date of discovery—used in the thirteen-word message. See *ante.*
51277	oblong=	*We have one position.*
51278	obtain=	*We have two positions.*

No.	Cipher-Word.	Corresponding Phrase.
51279	offend=	*We have three positions.*
51280	office=	*We will look for the object.*
51281	offset=	*Please look for the object.*
51282	onward=	*The announcement of the discovery of a comet (or planet) by———has been received here.* N. B.—The discoverer's name follows the cipher-word.
51283	oppose=	*Please forward the information by telegraph to———*
51284	orphan=	*Please do not forward the information to———*
51285	outcry=	*Please distribute this information by telegraph.*
51286	outfit=	*Please do not distribute this information by telegraph.*
51287	outset=	*It is for your private information only.*
51288	packet=	*Please verify before distributing.*
51289	palace=	*The foregoing appears to be somewhat doubtful.*
51290	pallid=	*For further information apply direct to———.*
51291	parade=	Please observe the object visually.
51292	parcel=	Please observe the object photographically.
51293	parent=	Please observe the object spectroscopically.
51294	parish=	*Aurora Borealis.*
51295	parrot=	*Zodiacal Light.*
		Control-Words.
51296	parson=	The sum of the numbers corresponding to all the number-words of eight letters (excluding words of three letters), in this message, up to and excluding the control-{word / or words} following is———
51297	pastor=	The following control-word is ½ of the sum of the two number-words of eight letters preceding it.
51298	patent=	The following control-word is ⅓ of the sum of the three number-words of eight letters preceding it.
51299	patrol=	The following control-word is ¼ of the sum of the four number-words of eight letters immediately preceding it.
51300	pebble=	The following control-word is $\frac{1}{5}$ of the sum of the five number-words of eight letters immediately preceding it.
51301	pedant=	The following control-word is $\frac{1}{n}$ of the sum of the n number-words of eight letters immediately preceding it (*i. e.*, of all such).

TABLE I (PREFIXES).

The table gives *numbers* (with Table II); *local mean dates* (if used alone; see Table III).

N. B.—Write three figures to correspond with each prefix. *Example:* *Fil*=070, not 70.

Vowels.	B	D	F	H	J	K	L	M	P	R	S	T	V	Vowels.	W	Y	Z	N
af	000	030	060	090	120	150	180	210	240	270	300	330	360	*af*	390	420	450	480
ak	001	031	061	091	121	151	181	211	241	271	301	331	361	*ak*	391	421	451	481
al	002	032	062	092	122	152	182	212	242	272	302	332	362	*al*	392	422	452	482
an	003	033	063	093	123	153	183	213	243	273	303	333	363	*an*	393	423	453	483
ap	004	034	064	094	124	154	184	214	244	274	304	334	364	*ap*	394	424	454	484
ar	005	035	065	095	125	155	185	215	245	275	305	335	365	*ar*	395	425	455	485
at	006	036	066	096	126	156	186	216	246	276	306	336	366	*at*	396	426	456	486
az	007	037	067	097	127	157	187	217	247	277	307	337	367	*az*	397	427	457	487
if	008	038	068	098	128	158	188	218	248	278	308	338	368	*if*	398	428	458	488
ik	009	039	069	099	129	159	189	219	249	279	309	339	369	*ik*	399	429	459	489
il	010	040	070	100	130	160	190	220	250	280	310	340	370	*il*	400	430	460	490
in	011	041	071	101	131	161	191	221	251	281	311	341	371	*in*	401	431	461	491
ip	012	042	072	102	132	162	192	222	252	282	312	342	372	*ip*	402	432	462	492
it	013	043	073	103	133	163	193	223	253	283	313	343	373	*it*	403	433	463	493
od	014	044	074	104	134	164	194	224	254	284	314	344	374	*od*	404	434	464	494
of	015	045	075	105	135	165	195	225	255	285	315	345	375	*of*	405	435	465	495
ok	016	046	076	106	136	166	196	226	256	286	316	346	376	*ok*	406	436	466	496
ol	017	047	077	107	137	167	197	227	257	287	317	347	377	*ol*	407	437	467	497
on	018	048	078	108	138	168	198	228	258	288	318	348	378	*on*	408	438	468	498
op	019	049	079	109	139	169	199	229	259	289	319	349	379	*op*	409	439	469	499
or	020	050	080	110	140	170	200	230	260	290	320	350	380	*or*	410	440	470	500
oy	021	051	081	111	141	171	201	231	261	291	321	351	381	*oy*	411	441	471	501
oz	022	052	082	112	142	172	202	232	262	292	322	352	382	*oz*	412	442	472	502
ud	023	053	083	113	143	173	203	233	263	293	323	353	383	*ud*	413	443	473	503
uf	024	054	084	114	144	174	204	234	264	294	324	354	384	*uf*	414	444	474	504
ug	025	055	085	115	145	175	205	235	265	295	325	355	385	*ug*	415	445	475	505
ul	026	056	086	116	146	176	206	236	266	296	326	356	386	*ul*	416	446	476	506
un	027	057	087	117	147	177	207	237	267	297	327	357	387	*un*	417	447	477	507
up	028	058	088	118	148	178	208	238	268	298	328	358	388	*up*	418	448	478	508
uz	029	059	089	119	149	179	209	239	269	299	329	359	389	*uz*	419	449	479	509

Explanation of Tables I, II, III.

Precepts: Table I. Read the initial at the top of the column with a combination from the column "Vowels"; as *Hok* = 106, *Noy* = 501.

I. All *numbers* are expressed by words of eight letters (invariably). Such words are made up of a *prefix* from Table I with an *affix* from Table II. Thus, 10647 = *Hokience;* 01065 = *Bilitous.* Numbers larger than 50999 must be divided into two parts, A and B, and telegraphed as A+B. Thus, 80711 = 40000+40711, which is telegraphed as *Wilnicht* plus *Wolahold,* and so on. When angles are in question, the degrees (only) are given by Table I, and the minutes by Table II; as 357° 29′ = *Tunegate;* 0° 15′ = *Bafalone.*

II. All *dates,* to the nearest day only, are expressed as *local mean dates* invariably in words of three letters (prefixes) taken from Table I, and interpreted by Table III. *Example: Hok* (standing alone) = 106^{d} = April 16 (local mean date); November 29 = 333^{d} = *Tan.*

III. To express the *Greenwich date* to the nearest hundredth of a day, use a number-word of eight letters from Tables I and II. Thus, February 29.67 = 60^{d}.67 = *Fafitude; Todilade* = 344^{d}.50 = December 10.50 (if the year is not a leap-year). A second number-word will give the seventh decimal of the day, if desired.

All ambiguity is avoided if the above precepts are obeyed, together with a few special precepts given in what precedes.

Numbers. TABLE II (AFFIXES).

These are always used with prefixes from Table I. N. B.—Write two figures to correspond with each affix. *Example:* Adieu is 04.

00	*-nicht*	**20**	*-arine*	**40**	*-estry*	**60**	*-iptik*	**80**	*-olute*
01	-aband	21	-aship	41	-eting	61	-irekt	81	-omane
02	-abate	22	-aside	42	-event	62	-irize	82	-omist
03	-about	23	-ation	43	-ibale	63	-iside	83	-omous
04	-adieu	24	-ative	44	-ibode	64	-itark	84	-oniks
05	-adize	25	-atrip	45	-ibrew	65	-itous	85	-opsis
06	-adore	26	-avish	46	-ident	66	-iture	86	-orate
07	-aflow	27	-eblow	47	-ience	67	-itude	87	-ordik
08	-afras	28	-educe	48	-ifold	68	-ivate	88	-ormus
09	-agile	29	-egate	49	-ijest	69	-oblat	89	-orous
10	*-aglow*	**30**	*-eglet*	**50**	*-ilade*	**70**	*-ocean*	**90**	*-ostik*
11	-ahold	31	-egraf	51	-ilant	71	-odate	91	-ugale
12	-akute	32	-ejekt	52	-ilege	72	-ofant	92	-ulate
13	-alist	33	-elekt	53	-imate	73	-often	93	-ulent
14	-alive	34	-elope	54	-iment	74	-ogism	94	-ulous
15	-alone	35	-embue	55	-imony	75	-ogive	95	-umate
16	-ament	36	-endow	56	-inary	76	-ogoon	96	-upate
17	-amope	37	-erade	57	-iness	77	-olist	97	-urant
18	-annex	38	-erkin	58	-inize	78	-olize	98	-urile
19	-arose	39	-eroon	59	-inode	79	-olode	99	-useep

Precepts: To express *numbers,* use Tables I and II; as *Manifold* = 21348. To express *angles, Manifold* = 213° 48′.

Dates. TABLE III. Day of the Year corresponding to each Month and Day (Common Years).

Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day of Month.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day of Month
1	1	32	60	91	121	152	**1**	182	213	244	274	305	335	**1**
2	2	33	61	92	122	153	**2**	183	214	245	275	306	336	**2**
3	3	34	62	93	123	154	**3**	184	215	246	276	307	337	**3**
4	4	35	63	94	124	155	**4**	185	216	247	277	308	338	**4**
5	5	36	64	95	125	156	**5**	186	217	248	278	309	339	**5**
6	6	37	65	96	126	157	**6**	187	218	249	279	310	340	**6**
7	7	38	66	97	127	158	**7**	188	219	250	280	311	341	**7**
8	8	39	67	98	128	159	**8**	189	220	251	281	312	342	**8**
9	9	40	68	99	129	160	**9**	190	221	252	282	313	343	**9**
10	10	41	69	100	130	161	**10**	191	222	253	283	314	344	**10**
11	11	42	70	101	131	162	**11**	192	223	254	284	315	345	**11**
12	12	43	71	102	132	163	**12**	193	224	255	285	316	346	**12**
13	13	44	72	103	133	164	**13**	194	225	256	286	317	347	**13**
14	14	45	73	104	134	165	**14**	195	226	257	287	318	348	**14**
15	15	46	74	105	135	166	**15**	196	227	258	288	319	349	**15**
16	16	47	75	106	136	167	**16**	197	228	259	289	320	350	**16**
17	17	48	76	107	137	168	**17**	198	229	260	290	321	351	**17**
18	18	49	77	108	138	169	**18**	199	230	261	291	322	352	**18**
19	19	50	78	109	139	170	**19**	200	231	262	292	323	353	**19**
20	20	51	79	110	140	171	**20**	201	232	263	293	324	354	**20**
21	21	52	80	111	141	172	**21**	202	233	264	294	325	355	**21**
22	22	53	81	112	142	173	**22**	203	234	265	295	326	356	**22**
23	23	54	82	113	143	174	**23**	204	235	266	296	327	357	**23**
24	24	55	83	114	144	175	**24**	205	236	267	297	328	358	**24**
25	25	56	84	115	145	176	**25**	206	237	268	298	329	359	**25**
26	26	57	85	116	146	177	**26**	207	238	269	299	330	360	**26**
27	27	58	86	117	147	178	**27**	208	239	270	300	331	361	**27**
28	28	59	87	118	148	179	**28**	209	240	271	301	332	362	**28**
29	29	..	88	119	149	180	**29**	210	241	272	302	333	363	**29**
30	30	..	89	120	150	181	**30**	211	242	273	303	334	364	**30**
31	31	..	90	...	151	...	**31**	212	243	...	304	...	365	**31**

Precepts: In leap-years, add one day after February 28. This table is to be used in connection with Table I to obtain the *local mean date* to the nearest day. Thus, August 10 = 222 days = *Mip.*

It is to be used in connection with both Tables I and II to obtain the Greenwich date to the hundredth of a day. Thus, August 10.16 = 222^{d}.16 = *Mipament.*

TABLE V. To change Decimals of a Day to H. M. S.; and conversely.

A. Hundredths of the Day.

D	h	m	s
0,01	0	14	24
0,02	0	28	48
0,03	0	43	12
0,04	0	57	36
0,05	1	12	0
0,06	1	26	24
0,07	1	40	48
0,08	1	55	12
0,09	2	9	36
0,10	2	24	0
0,11	2	38	24
0,12	2	52	48
0,13	3	7	12
0,14	3	21	36
0,15	3	36	0
0,16	3	50	24
0,17	4	4	48
0,18	4	19	12
0,19	4	33	36
0,20	4	48	0
0,21	5	2	24
0,22	5	16	48
0,23	5	31	12
0,24	5	45	36
0,25	6	0	0
0,26	6	14	24
0,27	6	28	48
0,28	6	43	12
0,29	6	57	36
0,30	7	12	0
0,31	7	26	24
0,32	7	40	48
0,33	7	55	12
0,34	8	9	36
0,35	8	24	0
0,36	8	38	24
0,37	8	52	48
0,38	9	7	12
0,39	9	21	36
0,40	9	36	0
0,41	9	50	24
0,42	10	4	48
0,43	10	19	12
0,44	10	33	36
0,45	10	48	0
0,46	11	2	24
0,47	11	16	48
0,48	11	31	12
0,49	11	45	36
0,50	12	0	0
0,51	12	14	24
0,52	12	28	48
0,53	12	43	12
0,54	12	57	36
0,55	13	12	0
0,56	13	26	24
0,57	13	40	48
0,58	13	55	12
0,59	14	9	36
0,60	14	24	0
0,61	14	38	24
0,62	14	52	48
0,63	15	7	12
0,64	15	21	36
0,65	15	36	0
0,66	15	50	24
0,67	16	4	48
0,68	16	19	12
0.69	16	33	36
0,70	16	48	0
0,71	17	2	24
0,72	17	16	48
0,73	17	31	12
0,74	17	45	36
0,75	18	0	0
0,76	18	14	24
0,77	18	28	48
0,78	18	43	12
0,79	18	57	36
0,80	19	12	0
0,81	19	26	24
0,82	19	40	48
0,83	19	55	12
0,84	20	9	36
0,85	20	24	0
0,86	20	38	24
0,87	20	52	48
0,88	21	7	12
0,89	21	21	36
0,90	21	36	0
0,91	21	50	24
0,92	22	4	48
0,93	22	19	12
0,94	22	33	36
0,95	22	48	0
0,96	23	2	24
0,97	23	16	48
0,98	23	31	12
0.99	23	45	36
1,00	24	0	0

B. Ten-thousandths of the Day.

D	m	s
0,0001	0	8,64
02	0	17,28
03	0	25,92
04	0	34,56
05	0	43,20
06	0	51,84
07	1	0,48
08	1	9,12
09	1	17,76
10	1	26,40
11	1	35,04
12	1	43,68
13	1	52,32
14	2	0,96
15	2	9,60
16	2	18,24
17	2	26,88
18	2	35,52
19	2	44,16
20	2	52,80
21	3	1,44
22	3	10.08
23	3	18,72
24	3	27,36
25	3	36,00
26	3	44,64
27	3	53,28
28	4	1,92
29	4	10,56
30	4	19,20
31	4	27,84
32	4	36,48
33	4	45,12
0,0034	4	53,76
35	5	2,40
36	5	11,04
37	5	19,68
38	5	28,32
39	5	36,96
40	5	45,60
41	5	54,24
42	6	2,88
43	6	11,52
44	6	20,16
45	6	28,80
46	6	37,44
47	6	46,08
48	6	54.72
49	7	3,36
50	7	12,00
51	7	20,64
52	7	29,28
53	7	37,92
54	7	46,56
55	7	55,20
56	8	3,84
57	8	12,48
58	8	21,12
59	8	29,76
60	8	38,40
61	8	47,04
62	8	55,68
63	9	4.32
64	9	12,96
65	9	21,60
66	9	30,24
0,0067	9	38,88
68	9	47,52
69	9	56,16
70	10	4,80
71	10	13,44
72	10	22,08
73	10	30,72
74	10	39,36
75	10	48,00
76	10	56,64
77	11	5,28
78	11	13,92
79	11	22,56
80	11	31,20
81	11	39,84
82	11	48,48
83	11	57,12
84	12	5,76
85	12	14,40
86	12	23,04
87	12	31,68
88	12	40,32
89	12	48,96
90	12	57,60
91	13	6,24
92	13	14,88
93	13	23,52
94	13	32,16
95	13	40,80
96	13	49,44
97	13	58,08
98	14	6,72
99	14	15,36
0,0100	14	24,00

D	s
0,00000	0,000
1	0,864
2	1,728
3	2,592
4	3,456
5	4,320
6	5,184
7	6,048
8	6,912
9	7,776

D	s
0,000000	0,0000
1	0,0864
2	0,1728
3	0,2592
4	0,3456
5	0,4320
6	0,5184
7	0,6048
8	0,6912
9	0,7776